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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
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OBLON, SPIVAK, MCCLELLAND, MAIER & NEUSTADT, P.C.
1940 DUKE STREET
ALEXANDRIA, VA 22314

EXAMINER	
CHEN, TIANJIE	

ART UNIT	PAPER NUMBER
2652	16

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Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.	Applicant(s)	
	09/944,075	FUKUZAWA ET AL.	
	Examiner	Art Unit	
	Tianjie Chen	2652	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *04 June 2004*.

2a)☒ This action is **FINAL**. 2b)☐ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-18 and 21-25* is/are pending in the application.

4a) Of the above claim(s) *15-18* is/are withdrawn from consideration.

5)☒ Claim(s) *8 and 9* is/are allowed.

6)☒ Claim(s) *1-7,10-14,21,22,24 and 25* is/are rejected.

7)☒ Claim(s) *23* is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☒ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date *13*.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: _____.

Final Rejection

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which the subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

1. Claims 1-7, 10, 21, and 22 are rejected under 35 U.S.C. 103(a) as being unpatentable over Sakakima et al (US 6,567,246).

With regard to claims 1, 2, and 4; Sakakima et al shows a magnetoresistance effect element (Fig. 13) including: two ferromagnetic layers 3C and 5D, 3C being a magnetization fixed layer having a magnetization direction substantially fixed to one direction (Column 7, line 7), and 5D (Column 11, lines 41-42) being a magnetization free layer having a magnetization direction varying in response to an external magnetic field; a non-magnetic layer 4 (Column 13, lines 41-42) provided between the ferromagnetic layers; and a layer 31 with its boundary transition portion, containing an oxide (Column 19, line 46) as a principal component; the magnetoresistance effect element having a resistance varying in response to a relative angle between the magnetization direction of the magnetization fixed layer and the magnetization direction of the magnetization free layer.

Sakakima et al does not state that the layer 31 with its boundary transition portion contains a magnetic transition metal element, which does not bond to oxygen being inside the layer, and the transition metal is at least one of Co, Fe and Ni.

However, Sakakima et al teaches that the oxide magnetic film 31 can be formed by oxidizing part of the metal magnetic film 32.

It would have been obvious at the time the invention was made to one of ordinary skill in the art to find that the oxide layer with the boundary transition portion contains a magnetic transition metal element which does not bond to oxygen, which is at least one of Co, Fe and Ni and the magnetic transition metal element, which does not bond to the oxygen is being inside the layer. The rationale is as follows: in layer 32, which is not oxidized and the transition metal element is completely not bonded to oxygen; and layer 31 is an oxide layer, wherein the transition metal element is completely bonded to oxygen. Therefore, there must be a boundary transition portion wherein the bonding degree changes from zero to unit, and would contain magnetic transition metal element which is completely not bond to oxygen to completely bonded to oxygen. The layer 31 with its boundary transition portion would contain magnetic transition metal element which does not bond to oxygen and which is at least one of Co, Fe and Ni and the magnetic transition metal element, which does not bond to the oxygen is being inside the layer.

With regard to claim 2, Sakakima et al further shows the layer containing the oxide as the principal component contains a magnetic transition metal element of Co, which does not bond to oxygen and nitrogen (Column 6, lines 14-17).

With regard to claim 3, Sakakima et al further shows the thickness of the layer containing the oxide or nitride as the principal component is 2 nm (Column 10, lines 24-25), which is in the range of from 1 nm to 3 nm.

With regard to claim 5, Sakakima et al further shows that the layer 31 containing the oxide or nitride as the principal component is provided between layers 32 constituting the magnetization fixed layer 3C.

With regard to claim 6, Sakakima et al further shows the layer constituting the magnetization fixed layer between the non-magnetic layer and the layer containing the oxide or nitride as the principal component is 1 nm (Column 24, lines 54-57),

With regard to claim 7, Sakakima et al further shows that the magnetization fixed layer 3C includes: a layer 32 (Above 33) having a magnetization direction substantially fixed to one direction; a second non-magnetic layer 33; and a third ferromagnetic layer 32 (below 33) antiferromagnetically bonding to the layer having the magnetization direction substantially fixed to one direction, via the second non-magnetic layer 33.

With regard to claim 10, Sakakima et al does not explicitly show that the atomic composition of at least one of argon, xenon, helium, krypton and neon contained in the layer containing the oxide as the principal component is twice or more as much as the atomic composition of that in the layer which contacts the layer containing the oxide as the principal component.

However, it would have been obvious at the time the invention was made to one of ordinary skill in the art to recognize that the atomic composition of at least one of argon, xenon, helium, krypton and neon contained in the layer containing the oxide or nitride as the principal component is twice or more as much as the atomic composition of that in the layer which contacts the layer containing the oxide or nitride as the principal component. The rationale is as follows: Sakakima et al does not mention the layer which contacts the layer containing the oxide or nitride as the

principal component containing any one from the group of argon, xenon, helium, krypton and neon; i.e. the atomic composition is zero. Twice of zero is zero. One of ordinary skill in the art would have recognized that the atomic composition of at least one of argon, xenon, helium, krypton and neon contained in the layer containing the oxide or nitride as the principal component is twice or more as much as the atomic composition of that in the layer which contacts the layer containing the oxide or nitride as the principal component.

With regard to claim 21, Sakakima et al further shows that the current is applied between leads 13 in a direction parallel to the surfaces of two ferromagnetic layers (Fig. 14A; column 20, line 65).

With regard to claim 22, Sakakima et al further shows that the current is applied between leads 23 in a direction perpendicular to the surfaces of two ferromagnetic layers (Fig. 17; column 28, line 1).

2. Claims 11, 13, 14, and 24-25 are rejected under 35 U.S.C. 103(a) as being unpatentable over Gill (US 6,275,363) in view of Tan et al (US 5,962,080).

With regard to claim 11, Gill shows a magnetoresistance effect element in Fig. 12 including a spin valve film, the spin valve film including: a magnetization fixed layer having a ferromagnetic layer 226 having a magnetization direction 242 substantially fixed to one direction; a magnetization free layer 212 having a ferromagnetic layer having a magnetization direction varying in response to an external magnetic field; a non-magnetic intermediate layer 302 provided between the magnetization fixed layer and the magnetization free layer, and being metal Cu; a high conductive layer 304 having a higher conductivity than those of the magnetization

fixed layer and the magnetization free layer, being stacked on one side of the magnetization free layer 212 remoter from the non-magnetic intermediate layer 302; and a non-magnetic layer 220 provided on one side of the high conductive layer 304 remoter from the magnetization free layer 212, and containing a compound of an element Al, which is different from the principal element Cu constituting the high conductive layer 304 as a principal component.

Gill further shows that the non-magnetic layer is made of alumina (Column 6, lines 30-36), but does not specify the structure of the non-magnetic layer.

Tan et al shows a method of fabrication of crystalline non-magnetic layer of alumina for using as an insulating layer in magnetic head (Column 3, line 2-7), which is substantially non-magnetic and being substantially crystalline.

It would have been obvious at the time the invention was made to one of ordinary skill in the art to make the non-magnetic alumina layer be crystalline as taught by Tan et al. The rationale is as follows: Tan et al teaches that the crystalline alumina layer has better physical, electrical, and chemical characteristics (Column 3, lines 2-5). One of ordinary skill in the art would have been motivated by Tan et al's teaching to use crystalline non-magnetic layer thus obtaining better physical, electrical, and chemical characteristics.

With regard to claim 13, Gill further shows that the thickness of the non-magnetic crystalline layer 220 is 1 nm (Fig. 12), which is in the range of from 0.5 nm to 5 nm.

With regard to claim 14, Gill further shows the thickness of the high conductive layer 304 is 0.5 nm (Fig. 12).

With regard to claim 24, Gill further shows that the current is applied between leads 23 in a direction perpendicular to the surfaces of two ferromagnetic layers (Fig. 12).

With regard to claim 25, Gill further shows that the magnetoresistive element has tunnel junction effect, which is giant magnetoresistive effect.

3. Claim 12 is rejected under 35 U.S.C. 103(a) as being unpatentable over Gill in view of Tan as applied to claim 11, further in view of Sin et al (US 6,353,318).

With regard to claim12, Gill further shows the non-magnetic crystalline layer contains Al, but does not show it contains at least one selected from Si, Ge, W, Nb, Mo, P, V, Sb, Zr, Ti, Zn, Pb, Cr, Sn, Ga, Fe, Co and rare earth metals.

Sin et al shows a magnetoresistive sensor, wherein the SiO_2 and Al_2O_3 can be used as alternatives each other as a barrier layer (Column 5, lines 35-37).

It would have been obvious at the time the invention was made to one of ordinary skill in the art to include SiO_2 as an alternative for Al_2O_3 as taught by Sin et al. The rationale is as follows: using SiO_2 as an alternative for Al_2O_3 for barrier layer is notorious and commonly used in the art. Sin et al specifically teaches to use these two materials as alternatives. One of ordinary skill in the art would have been motivated to include SiO_2 as an alternative for Al_2O_3 thus improving the feasibility is fabrication.

Allowable Subject Matter

4. Claims 8 and 9 are allowed.

Claim 23 is objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

The following is a statement of reasons for the indication of allowable subject matter:

- With regard to claim 8, as the closest reference, Sakakima et al (US 6,567,246) shows a magnetoresistive element wherein the layer having the oxide as the principal component contacts an opposite surface of the magnetization free layer to a non-magnetic layer, **but does not show** the contact is via a second non-magnetic layer.
- With regard to claim 23, as the closest reference, a combination of Gill (US 6,275,363) and Tan et al (US 5,962,080) shows a magnetoresistance effect element including: a magnetization fixed layer, a magnetization free layer, a non-magnetic intermediate layer, a high conductive layer being stacked on one side of the magnetization free layer remoter from the non-magnetic intermediate layer; and a non-magnetic layer provided on one side of the high conductive layer remoter from the magnetization free layer, **but fails to show** that the current is applied between leads 13 in a direction parallel to the surfaces of two ferromagnetic layers (Fig. 14A; column 20, line 65).
- Applicant asserts that this second non-magnetic layer can reduce the magnetic field due to the current applied to the free layer (Specification, p. 34, lines 24-28).

Response to Arguments

5. Applicant's arguments filed 06/04/2004 have been fully considered but they are not persuasive.

- With regard to claim 1, the metal element not bond to oxygen is inside the layer as explained in the rejection.
- Tunneling junction is one kind of spin valve. See attached Knapp et al (US 6,330,137) column 2, line 25.
- With regard to claim 2, Applicant stated that a copy of Handbook of Magnetism was enclosed; however, it was not found in file. Examiner likes to remind Applicant that the situation in a completely oxidized area would be different with the situation in a transition area.

Conclusion

6. **THIS ACTION IS MADE FINAL.** Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the mailing date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Tianjie Chen whose telephone number is (703) 305-7499. The examiner can normally be reached on 8:00-4:30, Mon-Fri.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Hoa Nguyen can be reached on (703) 305-9687. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

Chen Tianjie

TIANJIE CHEN
PRIMARY EXAMINER